

Newsletter



Volume 11 Number 3

FOR PRIVATE CIRCULATION ONLY

AUSTRALIAN SOCIETY FOR LIMNOLOGY

NEWSLETTER

VOLUME 11 - NUMBER 3

October 1973

EXECUTIVE 1973/74

PRESIDENT: Dr D.F. McMichael (ACT)

VICE-PRESIDENT: Mr H.S. Midgley (Q)

SECRETARY/TREASURER : Mr D.E. Buckmaster (V)

EXECUTIVE COMMITTEE: Dr W.D. Williams (V), ex officio

Dr M.C. Geddes (Q)

Mr R.B. Humphries (ACT)

Mr B.J. McMahon (Q)

Dr J. Martin (V)

Dr D.A. Pollard (NSW)

Ms I.J. Powling (V)

Dr M.J. Thorne (Q)

Dr K.F. Walker (ACT)

BULLETIN EDITOR: Dr I.D. Hiscock (V)

EDITORIAL BOARD: Dr I.A.E. Bayly (V)

Ms I.J. Powling (V)

NEWSLETTER EDITOR: Dr K.F. Walker (ACT)

JOLLY AWARD SELECTION

COMMITTEE: Mr D.D. Lynch (T)

Dr D.F. McMichael (ACT)

Mr J.C.F. Wharton (V)

VENUE SUB-COMMITTEE: Dr M.C. Geddes (Q), coordinator

Mr B.J. McMahon (Q)

Mr H.S. Midgley (Q)

Dr M.J. Thorne (Q)

The Australian Society for Limnology (ASL) is an association of over 200 people with professional or amateur interests relating to the ecology of Australian inland waters. Since its inception in 1961, the society has played an important role in fostering limnological work in this country. The ASL also promotes effective liaison between limnologists in academic, private, and governmental institutions, and has a vested interest in the conservation of aquatic and terrestrial environments.

The society publishes a Bulletin, which appears at about yearly intervals, and contains scientific articles. An informal Newsletter is distributed about four times yearly, and includes notes on activities of members, book reviews, congress announcements, and articles of general interest. Special publications also are issued, although less frequently. A further periodical publication is the Directory of Australian limnologists.

Membership is open to any person or organization with an active interest in Australian limnology. Three classes of subscribing membership are catered for:

- (i) Ordinary members (annual subscription: \$6)
- (ii) Student members (annual subscription: \$3)
- (iii) Sustaining members (individuals, companies, or organizations contributing \$50 or more annually)

Enquiries regarding membership: Mr D.E. Buckmaster
 Hon. Secretary-Treasurer, ASL
 Fisheries and Wildlife Division
 Arthur Rylah Institute
 123 Brown Street
 Heidelberg, Victoria 3084.

NOTE FROM THE EDITOR

ANNUAL SUBSCRIPTIONS were due on 1 July. Those members whose subscription is still outstanding are reminded that, within the provisions of the recently-revised constitution, they will cease to be financial members of the society after 31 December 1973. Non-financial members forfeit all rights and privileges of membership. Since this is probably the last Newsletter this year, it may also be your last reminder! A tear-off form to accompany your remittance is attached to the back of this issue.

NOMINATIONS FOR THE JOLLY AWARD are invited, and should reach the Secretary/Treasurer by 31 October. The award is intended to honour individuals who have made significant contributions to limnology in Australia. To date only one nomination has been received.

IN CASE YOU WERE WONDERING, the change from quarto to A4-sized paper has been unavoidable, since the ANU Duplicating Pool does not deal with quarto. In any case, the change to A4 is in step with the change to metric measurements. Commonwealth Government offices, for example, have also switched to A4.

THIS ISSUE of the Newsletter contains several important items of interest. Some preliminary information on the forthcoming congress in Queensland is included; it seems likely the meeting will be held jointly with the Australian Marine Sciences Association (AMSA), although final arrangements have yet to be made. Also, if I may pre-empt the minutes of a recent (unconfirmed) Executive Committee meeting, it seems the proposed joint meeting with the New Zealand Limnological Society will not eventuate in 1974, for lack of a mutually-convenient time. There is still, however, a possibility of such a meeting at a later date (perhaps 1975).

SOME AMENDMENTS to the third edition of the Directory of Australian Limnologists are necessary. Some of these arise from an editorial oversight, and we do apologize to those members concerned.

MEMBERS will be interested to know that ALAN WEATHERLEY (Zoology, ANU, ACT) has accepted an overseas appointment, and will soon be leaving Australia. Alan has done a great deal to foster limnology in

this country and he will be greatly missed. However, we may take heart at the imminent return from New Zealand of GEOFF BRAND! Best wishes both to Alan and Geoff in their new appointments.

FINALLY, thank you to those who contributed the information that is the basis of this issue. As always, I would be very happy to receive further notes or comment on issues and activities, etc.

Keith Walker
Department of Environmental Biology
Research School of Biological Sciences
Australian National University
Canberra ACT 2601

* * * * *

ITEMS OF INTEREST

AT LAST, the Bayly-Williams book "Inland waters and their ecology" appears! The first printing was rather unsatisfactory, but a second version is imminent, and should be available by the time this Newsletter is distributed. A very limited edition has been printed, however, so if you want a copy, make your move soon.

* * * * *

IAN BAYLY, ALISTAIR GILMOUR, DON McMICHAEL, BRUCE MALCOLM, and DAVE POLLARD were among the interstate visitors to attend the recent Perth ANZAAS meeting. Congress symposia were more dominated by conservation themes than ever before. For example, the role of scientists, politicians, and bureaucrats was much-discussed, and both bureaucrats and politicians from state and federal organizations played an active role.

The Ord Ecology Symposium was highlighted by the political announcement that WA would push for the funds necessary to establish a Tropical Research Institute at Kununurra. Part of the work proposed for this institute will be fisheries and limnology - for example an investigation of changes in water quality and fish fauna in L. Argyle and the remaining downstream part of the Ord R.

NOEL MORRISSY (WA Marine Research Labs.) has been doing some preliminary work on L. Argyle, although considerable difficulties exist because of the remoteness of the area. Nevertheless, the powers that be have been made aware of the need for a monitoring program. At present, the main dam forming L. Argyle has impounded the whole of two years discharge from the Ord R., and the lake still is only two-thirds full.

* * * * *

ALAN WEATHERLEY (Zoology, ANU) has accepted an offer of a Chair in Fisheries Biology at the University of Tromsø, Norway. The University was opened in September 1972 and is charged with bringing a new intellectual life and special services and facilities to the people of North Norway. It is situated in the town of Tromsø (population 40,000) on the West coast of the Troms region (the Bismarck was sunk in a nearby fiord).

The major areas for rapid development in this new University are Medicine, Fisheries Biology (and cognate marine sciences), and Social Sciences. An eventual teaching staff of 500 and an undergraduate body of 3000 are expected by 1980.

In an attempt to create a regional university that will be of high quality while servicing the needs of this particular part of the country, the Government of Norway is spending large sums and obtaining expert guidance from various sources.

Directly or indirectly, many Norwegians are engaged in the fishing industry, and the University of Tromsø will be involved in teaching fishery science and hydrobiology and in much fundamental research on the fisheries of the region. The exact direction of the major research thrust is as yet undecided. Alan expects to play a part in deciding the possible lines to be followed and in devising and implementing the consequent research programmes. Because the University has been conceived on very freely-structured lines it should be possible to develop multi-disciplinary and open-ended studies that will - for example - give information on limitations and potential of fiord fisheries and on the regional possibilities for aqua-culture. These are just two of a number of possible research areas, among which are also fishery studies in the Barents Sea and population biology of freshwater fish. The social and economic life of the people of the Troms region may also become integrated into fishery studies because the University hopes for unified and cross-

-disciplinary approaches in its work.

Alan's interest in going to Tromsø derives from the challenge of great accessibility of extensive fish populations, diverse fishery problems, good research support of studies in hydrobiology, plus the opportunity to follow multi-disciplinary lines in biological research, requiring systems strategies for their solution.

* * * * *

GEOFF BRAND (Botany & Zoology, Massey U, NZ) has accepted a position (From December) as a Marine Ecologist with Fisheries and Wildlife in Melbourne. Geoff will be working on Western Port and Port Phillip as part of a group working to establish the major features of productivity in these waters, and his particular concern will be secondary productivity. In the meantime, Geoff is occupied in finishing a manuscript on copepod carotenoid pigments, writing up other parts of his thesis work, and also is tackling some problems relating to lipid storage in copepods, using scanning electron microscopy.

Geoff suggests that the ASL might produce an annual listing and summary of research projects. The New Zealand Limnological Society uses this format for their newsletter. Any comments?

* * * * *

BILL WILLIAMS (Zoology, Monash, V) flees in December for a two-year sabbatical. First stop is the Limnologisches Flußstation, Schlitz, Western Germany, for a couple of weeks. Then, via the Channel Bridge to England, where Bill will spend most of his time at the Ferry House - the Windermere Laboratory of the Freshwater Biological Association of the United Kingdom and British Empire (what Empire?). Whilst there, notwithstanding attempts to avoid answering all Australian correspondence, he intends to work (peace at last!) on the taxonomy of various Australian freshwater crustaceans, as well as British Asellus. All this while avoiding English income tax - not to mention his relatives. Scheduled date of return is a closely-guarded secret.

* * * * *

PETER TYLER (Botany, U Tas) has recently returned from a 13-month sabbatical, having done some limnological work in between filming trains. Altogether, these trains consumed 6,000 ft of film, although one brief shot is understood to show a lake (crossed by a railway bridge).

Early on, Peter collected desmids in Malaysia and Thailand, including a visit to the Department of Fisheries, Kasetsart University, and a collecting trip to the shallow lake Bung Borapet in central Thailand. Near Rangoon, he sampled Inya Lake from a leaky punt loaned by Madame Aung San, the widow of the assassinated first Premier of independent Burma, and all the while was watched through binoculars from the adjacent Russian Embassy. The best explanation he has for this is that he was wearing red underpants at the time.

Later, he collected desmids from the Mandalay area, then travelled south to Tennasserim into a politically-sensitive area, and was politely deported from Moulmein. On to the Botanical Gardens at Peradeniya, then some lakes at 5-6,000 ft SL in Sri Lanka. At the Annual Congress of the Southern African Limnological Society in Malawi, he contributed three papers in an effort to convey the message that Tasmania and Tanzania are not one and the same.

Still in Africa, Peter visited research stations on lakes Malawi, Chilwa and Kariba. At Kariba he looked at manganese deposits in the Central African Power Corporation's stations, and also found time to ogle Victoria Falls and the Zambesi R. Other discussion - and seminar - stopovers included the universities of Rhodesia, Orange Free State, Cape Town, Rhodes, Natal (Pietermaritzburg), Natal (Durban), Durban (Westville), Witwatersrand, Rand Afrikaans, and also the National Water Research Institute in Pretoria. At Bloemfontein (Orange Free State) he held discussions ^{on} Sub-Antarctic limnology with their Marion Island team.

Another four days were spent sampling estuarine lakes with Rhodes limnologists. Homage was paid to a coelocanth at the Smith Ichthyological Institute and, before leaving Africa, a visit was also paid to desmidiologist Gerry Prowse in Roma, Lesotho.

Peter studied ultrastructure of desmids at Leeds in England, and collected live desmids - for dispatch to Tasmania - from the Hebridean Islands and the west of Scotland. Other stopovers in Britain included visits to Ian Potter at Bath U, and the FBA at Windermere.

The return journey through Burma and Java included pauses to film the Burma-Siam railway and the insurgent Karen and Mon armies, and to

sample the River Kwai from source to junction with the Mae Khlong in a study of the role of SW monsoons in supply of salts to terrestrial forests.

* * * * *

BRENTON KNOTT (Zoology, U Tas) has made a brief study of the stomach contents of 433 trout collected between 1971-3, from various localities in Tasmania. A brief account of this work appears in a recent book "The Tasmanian Trout" by D. Gilmour, under the title, "What Tasmanian trout eat now and what will they eat next?".

* * * * *

"THE LAKE COUNTRY OF TASMANIA" is the title of a recently-published symposium, edited by M. Banks for the Royal Society of Tasmania (199 p.). Articles of interest include "On the freshwater crustaceans of the Central Plateau" (P.S. Lake and B. Knott), "Aquatic insects" (G. Wade), "Introduced fish" (D.D. Lynch), "Native fish" (A.P. Andrews), and "Management of water yield" (I.J. Edwards).

* * * * *

PRELIMINARY CONGRESS INFORMATION

As this issue of the Newsletter goes out, arrangements are being made for the next Annual Congress which hopefully will be a joint meeting with the Australian Marine Sciences Association (AMSA).

The venue, and other details, have not yet been decided with any finality. Difficulties have arisen in finding a venue with sufficient accommodation, but the place will certainly be somewhere in south-eastern Queensland, and the meeting will be during the May vacation.

It is likely that concession air-travel can be arranged, providing enough people are interested.

It will be necessary to make reservations fairly early. Members can expect a circular with details sometime later this year.

* * * * *

A LETTER FROM A (TEMPORARY) EXPATRIOT

9 August 1973

Dear Colleagues

Having a foot on both sides of the Tasman, I was encouraged to communicate the following thoughts because of the present bilateral interest in a joint Australian-New Zealand Limnology Congress.

In general terms, the gains to antipodean workers from a joint meeting of the ASL and NZLS will be obvious. (Besides, the beer's good here too!) However, while much individual liaison already exists, many Australian limnologists may not be aware of the breadth and relative strength of freshwater studies in New Zealand. Limnology is represented on six campuses, at least three of which offer courses in the subject; relevant work is also carried out by the Marine Department, and two groups within the D.S.I.R. - the New Zealand Oceanographic Institute and the Ecology Division (in which there is in fact a Freshwater Section). A perusal of studies reported in the NZLS (1972) newsletter indicates the scope of research; work on streams and lakes includes systematics and general limnology, autecology, aquaculture, freshwater fisheries, primary and secondary productivity, microbiology, weed and algal problems.

The Society is involved in the Officials Committee on Eutrophication, which pools the efforts of numerous government departments, and in the National Committee for Water Pollution Research. Members can avail themselves of data from a growing Central Registry of Information on literature relevant to New Zealand eutrophication research, maintained by the Freshwater Section, D.S.I.R. In fact limnologists in both countries have equal scope for involvement in decision-making regarding the conflicting demands for water resources. Pedder has its equivalent in Lake Manapouri.

So, with the impertinence of a biologist who keeps falling in lakes, may I suggest that a consideration of the "Biology and Biogeography of Australian Freshwater Organisms" proposed for the joint meeting be only the starting point for generally closer formal liaison.

As a specific suggestion, perhaps mutual circulation of both Societies' Newsletters could be negotiated. We may thereby find, as I have, that someone else is grappling with a similar problem, perhaps on the same species.

GEOFF. W. BRAND
Lecturer in Zoology
Massey University
Palmerston North
NEW ZEALAND

RECENT RESEARCH

The following are brief accounts of the work of 1972 Honours students working with Sam Lake in the Zoology Department, University of Tasmania.

V.J. THORP. "Ecological studies of a zinc- and cadmium-polluted river, and an investigation of the physiological and histological effects of cadmium on selected invertebrates."

The study site was the stretch of the South Esk R. between Fingal and Evandale. Fauna at polluted stations was reduced both in numbers and species, with Crustacea, Annelida, and Mollusca being most adversely affected. Laboratory 96-hour toxicity assays indicated that the prawn Paratya tasmaniensis and the amphipod Austrochiltonia subtenuis were highly susceptible (LC_{50} values of ca. 0.04-0.06 mg Cd/l). The ephemeropteran Atalophlebia australis was intermediate in sensitivity (LC_{50} : ca. 1 mg Cd/l), and the odonate Ischnura heterosticta and trichopteran larvae proved extremely resistant. Investigations also were carried out on zinc toxicity and the nature of interaction (as regards toxicity) between cadmium and zinc with Paratya.

P.C. ROBERTS. "The taxonomy and some aspects of the ecology of a new species of Heterias ... from Lake Crescent, Tasmania."

It appears the rocky shores of L. Crescent harbour a new species of the isopod Heterias. Thus, in Victoria, H. pusilla (Sayce 1900) occurs, while in Tasmania at least two parasellid species occur, viz. Pseudasellus nichollsi Chappuis (1951) and the new Heterias. The life history of the new species was investigated, and observations also were made on predation of the species by two planarian species.

T.M. WALKER. "A study of the morphology, taxonomy, biology, and some aspects of the ecology of Paratya australiensis Kemp from Tasmania."

It appears that P. tasmaniensis Riek is almost certainly P. australiensis Kemp. Distribution, habitat requirements, life history, growth rate, reproduction, and sex ratio were investigated for two populations - one in a stream, and another in a small lake. Aspects of the physiological ecology of the species also were studied.

RESEARCH IN PROGRESS

BRENTON KNOTT (Zoology, U Tas) is a Ph.D. student working with Sam Lake on problems of phreatoicid taxonomy and distribution. Collections of phreatoicids from Tasmania and the mainland are being employed in a taxonomic re-evaluation of Nicholl's earlier classification. Results to hand suggest that Nicholl's classification - at the family, genus, and species levels - is in desperate need of revision. Present work suggests that only six specific taxa are required to accommodate all Tasmanian populations of phreatoicine phreatoicids, rather than the many species described by Nicholls.

Although Great Lake no longer has the diversity and abundance of phreatoicids that Nicholls found - only two species now occur there - it remains an important link in explaining phreatoicid evolution and distribution.

* * * * *

SAM LAKE (Zoology, U Tas) this year has two Honours students doing work of limnological interest. Mr M. CASSIDY is investigating aspects of cadmium toxicity in the galaxiid, Galaxias maculatus, and Mr B. MILLS is looking at calcium metabolism in crayfish of the genera Parastacoides and Astacopsis.

* * * * *

NOEL MORRISSY (WA Marine Research Labs.) is commencing a large, experimental field programme with national funds (\$22,000 in 1973-74), investigating aquaculture of marron (Cherax tenuimanus) in small farm storages in arid inland areas. Published reports of related work by Noel have recently appeared; see, for example, Aust. J. mar. Freshwat. Res. 24: 183-95.

Prior to ANZAAS, Noel was the only biologist to accompany a large group of Australian hydrologists on a field-tour of the south-west. There is some very interesting work being done in that area by CSIRO Land Management people on the relationship between salinities of runoff and groundwater and the influence of forest-clearing on this relationship. At present bauxite mining interests are marching eastwards across the State Jarrah Forests, and a large wood-chip industry is proposed for the State Forests of the extreme south-west.

Groundwater in inland areas of the southwest - where annual rainfall may be less than 1100 mm - has accumulated cyclic salts as a consequence of low rainfall, high evaporation, and high evapotranspiration by deep-rooted salt-tolerant eucalypts. Clearing and grazing has been associated with increased salinization of surface waters, due partly to rising water tables and partly to increased runoff from the large salt lake systems further inland.

The above has become of considerable interest to people concerned with the future water-quality of southwest streams. Noel in particular is looking at the inland boundary to the natural distribution of marron, starting with a study of crayfish abundance along the major Blackwood R. system, which has increased in mean salinity by a factor of 3.5 over the past fifty years. Noel's wife, Lesley, has a similar interest, in terms of the taxonomy of the entire inland crayfish fauna, for her M.Sc. thesis.

* * * * *

JOHN DEAN (MMBW, V) recently has commenced work with the MMBW after spending four years with the Metropolitan Water, Sewerage, and Drainage Board in Sydney. He is about to commence a study of the zooplankton of Greenvale Reservoir, a recently - completed storage reservoir about 16 km north of Melbourne. Samples will be taken fortnightly, and particular attention will be paid to seasonal variations in abundance of the major species and patterns of vertical distribution. Supplementary data on phytoplankton and temperature-dissolved oxygen profiles will be collected. John hopes to undertake a similar program on the Cardinia Reservoir when it starts to fill in the next year or so.

For comparison a survey of other Melbourne water storage reservoirs will be undertaken, to ascertain Zooplankton and algal associations and to generally characterise the reservoirs limnologically.

John also is particularly interested in running-water ecology. He is at present working through benthic samples collected during 1972-3 from the Kangaroo River, a tributary of the Shoalhaven River (NSW). Each month samples were collected from three different habitat types: rapids, riffles, and pools. As might be expected there were considerable differences in the faunas of the three habitat types. John intends to work out life-histories, food, and feeding relationships, microdistributions and other aspects of the ecology of the more common invertebrate

species. To date only the Ephemeroptera have been looked at in any detail. At least twenty-two species are present in the samples, fifteen of which belong to the family Leptophlebiidae. Pools, with seventeen species, support a more diverse mayfly fauna than either riffles or rapids.

* * * * *

KEN MCKENZIE (Riverina College of Advanced Education, NSW) is presently concerned with completing an illustrated key to South African freshwater ostracods, as well as determinations of fresh-Ostracoda from southern Australia (perhaps leading to publication). Ken also is looking at marine species, particularly in the region of the Northwest Shelf.

* * * * *

SYED HUSSAINY (MMBW, V) has been largely responsible for setting-up and operating the Control Laboratory at the Werribee sewerage farm. Syed's principal interest has been to investigate factors affecting the efficiency of lagoon treatment (aerobic and anaerobic). Some of the parameters that have been investigated are biochemical oxygen demand, suspended solids, hydrogen sulphide, dissolved oxygen, temperature, pH, detention time, and sludge volume. Sludge volume and temperature have emerged as perhaps the most important factors. These observations have been used to construct a mathematical model with which Syed hopes to anticipate lagoon performance for a given set of conditions.

An important facet of Syed's work has been the relative importance of bacterial, rather than algal, chlorophyll (see Aust. Soc. Limnol. Bull. 5: 26-8 (1973), and Wat. Res. 6: 1361-5 (1972)). Syed would be most obliged to hear from any colleagues who may have been routinely measuring chlorophyll elsewhere in Australia. If sufficient data are obtained, they might be used to support Syed's contention that bacteriochlorophyll is of considerable general importance. The information required is as follows:

date	-	locality	-	volume	-	volume of	-	optical densities at
				filtered		90% acetone		850, 772, & 663 nm

Address: Dr S.U. Hussainy
Control Laboratory
MMBW Farm
Werribee Vic. 3030

LAUREL FOX (Environmental Biology, ANU, ACT) is a relatively recent arrival from Santa Barbara, California, where she completed a Ph. D. dissertation considering the effects of food limitation, cannibalism, and interactions within communities of predatory aquatic insects. In Australia, Laurel is maintaining her interest in predator-prey interactions in aquatic communities, while also developing an interest in the nature of host-specificity among sawflies found associated with eucalypts.

* * * * *

BOB HUMPHRIES (Environmental Biology, ANU, ACT) is a Ph.D. student working (with Keith Walker) on aspects of community structure in farm ponds. Since European settlement, the importance of artificial water storages has increased to the extent that natural aquatic environments are far out-numbered by their man-made counterparts. Artificial impoundments obviously have considerable ecological importance in this country, yet they have been little-studied. Farm ponds, for example, remain virtually unexploited by Australian ecologists, although small size and high density distribution of these ponds make them highly amenable to observation and experimental manipulation. One facet of the present work is to examine the effects of macrophytes on community structure; and another is to compare the biota of ponds of different physical and chemical characteristics. Important obstacles to be overcome are the great biological diversity and relative environmental instability in such situations.

* * * * *

KEITH WALKER (Environmental Biology, ANU, ACT) is cultivating an interest in the taxonomy and ecology of Australian aquatic Hemiptera. He would be grateful to receive collections from any part of Australia. If you want them identified anyway, so much the better!

* * * * *

LATE CONFERENCE ANNOUNCEMENTS

FIRST INTERNATIONAL CONGRESS OF ECOLOGY, The Hague, 8-14 September, 1974.

Organized by the International Association for Ecology (INTECOL) under auspices of the International Union of Biological Sciences (IUBS), and in cooperation with the International Biological Programme (IBP). The main theme of the congress will be discussion of unifying concepts. Deadline for registration: 1 November 1973. Write: P O Box 9000, The Hague, Netherlands.

SEVENTH INTERNATIONAL CONFERENCE ON WATER POLLUTION RESEARCH, Paris, 9-13 September, 1974.

Deadline: 7 November, 1973. Details: Dr S.H. Jenkins

Upper Tame Main Drainage

Authority

156/170 Newhall Street

Birmingham B3 1SE

England

(Who is the Australian rep.?)

* * * * *

LIMNOLOGY IN SOUTHERN AFRICA

The following notes are extracted from the May 1973 issue of the News Letter of the Limnological Society of Southern Africa. For further details, contact me. (-Ed.)

*International Crocodile Meeting. (Delegates were not crocodiles, as you might think) A report of a working meeting to review current knowledge, held at Ndumu and St. Lucia in March. Organized by the International Union for Conservation of Nature (IUCN), and funded by the New York Zoological Society.

*Limnological bibliography for Africa south of the Sahara. An extensive listing of publications for 1972-73, with addenda for earlier years.

- *Kruger, E.J. and P.F.S. Mulder. 1973. Gut length and food habits of fish - a note. News Lett. Limnol. Soc. South Afr. 20: 1-7. (The ratio of gut length to fork length was established for several South African species of each of the genera Labeo, Tilapia, and Barbus and also for Cyprinus carpio, Clarias gariepinus, and Eutropius depressirostris. Four groups could thus be distinguished and these were associated with food habits, viz. herbivorous, omnivorous, carnivorous, and detritus feeders.)
- *Walmsley, R.D., C.M. Breen, and E. Kyle. 1973. Aspects of the fern-alga relationship in Azolla filiculoides. ibid. 20: 13-21.
- *Eckard, D.M. 1973. Notes on Zululand mosquitos with unusual habits. ibid. 20: 9-11.
- *Breen, C.M. 1973. Ecological implications of recent research on the genus Volvox. ibid. 20: 23-28.

* * * * *

RECENT PUBLICATION

Due to an oversight, the following paper was omitted from the recent publications list.

- BERRA, T.M., and A.H. WEATHERLEY. 1972. A systematic study of the Australian freshwater serranid fish genus Maccullochella. Copeia 1,53-64.

Since this paper is on a subject of interest to a number of members, I think it worthwhile to reproduce the abstract here. (-Ed.)

Whether one or two species in the genus Maccullochella should be recognized has been argued for many years. This study, based upon the examination of 210 specimens ranging in size from 31-1235 mm SL reveals that the recognition of two species is warranted. Examination of the type material indicated that the correct name for the Murray cod should be M. peeli (Mitchell, 1838) and the trout cod should be referred to as M. macquariensis (C & V, 1829). This latter species is distinct by virtue of its overhanging upper jaw, straight head slope, longer snout, three pyloric caeca,

14P/21C vertebral regime, grey color, and speckled pattern as opposed to peeli which has equal jaws, a concave head slope, shorter snout, three or four pyloric caeca, 15P/20C vertebral count, green color and mottled pattern. Slight immunoelectrophoretic differences were also detected.

* * * * *

MINUTES

Minutes of the second Executive Committee meeting, held 9-8-73, are to hand, but await confirmation in a third meeting scheduled for late September or early October. The major item of interest relates to postponement of plans for a joint Australia-New Zealand limnology meeting, as mentioned earlier. (-Ed.)

AUSTRALIAN SOCIETY FOR LIMNOLOGY

MINUTES

FIRST EXECUTIVE COMMITTEE MEETING

Court House Hotel, Jamieson, Vic.

13.5.73

Present Dr D McMichael (President)
Mr D Buckmaster (Secretary-Treasurer)
Ms J Powling, Dr D Pollard, Mr B McMahon, Dr M Thorn,
Mr M Geddes, Dr J Martin.

Apologies Remaining members of Executive.

Business

I.A.S.L. Bulletin

Dr I Hiscock was appointed Editor for the ensuing year, and Dr I Bayly and Ms J Powling were appointed as members of the Editorial Board.

2. Newsletter

Dr Keith Walker was appointed Editor.

3. Selection Committee - Jolly Award

The Executive appointed a committee of three:-

Dr D McMichael (Chairman)
Mr D D Lynch
Mr J C F Wharton

Nominations for this award are to be forwarded to the Secretary-Treasurer.

4. Venue - 1974 Annual Congress

A sub-committee was elected to explore the suitability of various venues in Queensland, and report back to the Secretary-Treasurer before July 31st.

Sub-committee:- Mr. H. Midgley; Dr M Thorn; Mr R McMahon
(Co-ordinator - Mr M Geddes).

5. Date - 1974 A.G.M. and Annual Congress

Provisional date set for May 1974.

6. Sustaining Membership

It was agreed that Dr D McMichael and Dr K Walker should produce an explanatory leaflet on this particular matter.

7. Next Executive Committee meeting

No date was set, but it was agreed that future meetings would probably be timed to coincide with future visits to Melbourne by the President.

The Secretary-Treasurer would in these cases ensure that a quorum would be available if a meeting was deemed necessary. Such meetings would necessarily involve Ms J. Powling and Dr J. Martin.

8. Annual Subscription

In lieu of any motion to the contrary at the A.G.M., the annual sub. remains at \$6.00.

9. Dr. G Likens - appointment as Honorary Member

The executive agreed to confer Honorary Membership on Dr. G. Likens (Cornell University, (USA), for the duration of his stay in Australia.

The Secretary-Treasurer to inform Dr Likens in writing of this decision, and prepare a suitable report for the Newsletter.

10. Joint meeting - Australian and New Zealand Societies

Secretary-Treasurer to write to President - elect of New Zealand Society outlining the following -

- (a) the A.S.L. is interested in a joint meeting.
- (b) a suitable time would be Jan-Feb. 1974.
- (c) the A.S.L. would suggest a venue in the Rotorua-Taupo area, where both limnological and lesser academic interests could be satisfied at the one time.
- (d) a joint meeting which clashed with our own Congress in May 1974 would not be acceptable.

11. Meeting Closed : 11.00 p.m.

(Signed) D.E. BUCKMASTER,
Secretary-Treasurer.

A PLEA FOR CONSERVATION OF AQUATIC ECOSYSTEMS

DR. P.S. LAKE (Zoology, U Tas) has kindly made available the following paper, which he presented in Hobart, Launceston, and Burnie, as one of the Winter Series of Lectures (1973). I think it well-worthwhile reproducing in full since the subject is of fundamental importance to the ASL, and because the lecture might not otherwise be accessible to many members. Incidentally, similar sorts of material from other members would be welcomed! (-Ed.)

* * * * *

AQUATIC ECOSYSTEMS - CONFLICTING INTERESTS AND CONSERVATION

I would like to start by apologising for the rather imprecise timidity of the title of my lecture. For in truth tonight, I will be talking about the present circumstances that aquatic ecosystems, especially in Australia and Tasmania, are in from a biological point of view. I hope also to step outside the realm of aquatic ecosystems and state some observations, for what they are worth, on possible desirable steps that can be taken to allay the various levels of environmental concern.

At present, aquatic ecosystems are being deliberately or accidentally degraded and destroyed with little or no effort being exerted as to their conservation or preservation. It appears that it is only when we are surrounded by the junk of our environmental 'victory' that we belatedly make attempts to question such 'success'. For a poetic expression of this simple but perturbing truth, the reader is referred to James McAuley's poem "Wet Day". The poem evokes a powerful sense of Tasmanian east coast estuaries; some of which although remote and superficially untouched have imperceptibly been degraded by man.

An ecosystem may be defined as the assemblage of populations of organisms of an area together with the physical and chemical attributes and resources of that location. In describing an ecosystem we usually refer to a system with distinct boundaries. In an ecosystem, we not only consider the abiotic and biotic components present at any one time but we must also consider the pathways by which energy enters and moves through the ecosystem. Geared with the movement of energy in an ecosystem, there is also the need to characterize the movement, however slow it is, of chemical elements essential to life. The pathways of these chemical elements may be cyclic, e.g., nitrogen, but others are only partly cyclic, e.g., phosphorus. This movement of elements or energy may ofcourse involve a number of discrete ecosystems, not just one. From the point of view of man, natural ecosystems perform an absolutely essential task "the replenishment of supplies of essential ingredients of life, e.g. atmospheric oxygen, inorganic phosphorus."

An ecosystem consists of two major components; the abiotic and the biotic. The biotic component is most usefully divided up into separate inter-related compartments on the basis of their energy source. Thus in any ecosystem, we have the producers - the plants which convert solar energy into stored potential energy by the process of photosynthesis. In turn the producers are possibly eaten by the consumers - mostly animals. Operating on both of these groups is a third rather unseemly group, the decomposers - largely fungi and bacteria. An ecosystem can thus be represented as a complexity of trophic inter-relationships.

In a typical lacustrine ecosystem, one may have a producer complex of phytoplankton and sessile plants. Primary consumers or herbivores such as the crustacean zooplankton will consume the phytoplankton; other animals such as insect larvae and nymphs may consume the sessile plants. The primary consumers may be preyed upon by secondary consumers such as fish. In turn these fish may be eaten by other fish or by birds. The top consumers have only a small fraction of the biomass produced by the producers at the base of the trophic pyramid. In turn, a complex galaxy of bacteria and fungi decompose the carcasses of all of the above trophic levels.

Natural ecosystems comprise an assemblage of organisms that have become adapted to the local physical conditions. Undisturbed, natural ecosystems are in stable equilibrium with their constantly changing environment, and it appears that the maturity and stability of an ecosystem are directly related. The stability is directly related to the biological diversity of the ecosystem. Thus natural ecosystems in their evolution, tend to move toward great stability, often in spite of great environmental instability, and toward greater diversity. Richness of species appears to be a natural goal. Thus tropical lowland rain forest ecosystems or tropical coral reef ecosystems have evolved in conditions of great physical stability and this is immediately detectable by the cornucopia of species.

To understand the effects of exploitation on aquatic resources, or to elucidate means to conserve aquatic resources, the most satisfactory unit to investigate is the ecosystem. It is also the most difficult. The ecosystem concept assumes an internal structure of inter-relationships. It is important to realize that when an ecosystem is altered, the effects on the various components are rarely fully predictable, but yet nevertheless, by operating at an ecosystem level, one can see that a network of components may be involved. Some effects arise by indirect means. Thus the operations of clear cutting on a watershed, e.g., for woodchips, may be expected to affect a stream ecosystem by increasing the stream's silt load, or increasing temperature fluctuations, or increasing the turbidity. Work in New Hampshire, U.S.A. by Bormann on the effects of clear cutting has shown that the nitrate concentration of a stream flowing from a clear-felled watershed rose to such an extent that algal blooms (usually rare in streams) occurred in summer - an unnatural and undesirable situation and not one that was expected.

For too long, we have devised schemes for the management of aquatic resources by considering only small seemingly isolatable parts of an ecosystem, such as a particular species population and a particular use. Very rarely has comprehensive information on an aquatic ecosystem been sought before a management policy, however ill-directed, has been instituted. It is no wonder people do not deplore the depreciation and destruction of ecosystems when they know very little indeed about them in the man-uncorrupted state. If one accepts that man is only one species of the biosphere and is governed in the long-term success of his environmental innovations by ecological forces, possibly even laws, such as the innovations of other organisms are governed, then the ecological outcomes of man's environmental actions can be judged on a sliding scale of severity. From a zero level of no permanent interference, one can go through levels where man's actions are certainly detectable yet are not irreversible - through to the far more familiar situation where man's actions are only too evident, too destructive and too permanent.

Since the advent of settlement, European man has, by direct and indirect means, degraded the greater proportion of Australia's freshwater and estuarine ecosystems. It is very difficult to find a freshwater ecosystem that has not been damaged in some way. Without, at this stage, judging the propriety of such a state, let us examine briefly the major methods that man has used to alter aquatic environments.

Possibly, the most controversial, and on a world-wide scale, most plentiful form of environmental degradation is that induced in aquatic ecosystems by pollution. By pollution, I mean the addition by the operation of human activities of materials and/or energy into an ecosystem in amounts above those to which that ecosystem is adapted to accept or deal with. Thus pollution in its usual layman sense largely covers the addition of toxins, but in some instances, pollution may result from a surfeit of a good thing, e.g. too much phosphorus. The result of all pollution, be it transitory or long term is to modify ecosystems in a detrimental direction. By detrimental, I am referring to such changes as loss of species, loss of ecosystem diversity and stability, possibly even loss of beauty - or simply, the creation of ecologically depauperate conditions. Pollution of an aquatic ecosystem in our society at present, is usually and solely defined in terms of physical and chemical parameters. Such criteria based largely on notions of resource compartmentalization and thus administrative compartmentalization, are only of limited value in terms of understanding pollution. Pollution is an ecological process and should in my opinion never be regarded as otherwise. It is the effect of a pollutant on an ecosystem which from an environmental point of view, is of paramount importance. It has often been calimed that to monitor pollution ecologically is too expensive and time-consuming and that it is more worthwhile to measure the levels of a few physical and chemical factors. This may well be true in a society where levels of pollution have become high enough to threaten man. But before such a predicament is reached there should be adequately planned and financed research into the ecological effects of pollutants.

In broad general terms, pollution is a phenomenon which nearly everyone at some stage becomes indignant about. This indignation is based frequently

on the supposition that pollution is an accidental problem, or at best a phenomenon created by profit or citation-hungry industrialists. However, as argued by many of the much maligned 'prophets of doom', e.g. Ehrlich, Commoner, pollution is a direct consequence of our desire to live in an affluent society, either served or controlled by technology. To quote Frank Fraser Darling, 'Escalating technology has produced many of the enveloping forms of pollution we deplore, but, it could be turned the other way as well, if we are willing to pay for it. When we say, 'We've never had it so good', could we not also see that we have never had it so bad? So little of the so-called 'goods' would need to be sacrificed to relieve some of the threats of envelopment by pollution.'

Some may argue further that the difficulty lies in our addiction to the force of technology. As Fraser Darling states 'Jehovah has been steadily losing out since the Renaissance though he has fought a good rearguard action. In our century we have seen the mantle of Jehovah passed to Science with a capital S. But science.... is impersonal and is but truth and understanding as we see it at any one time. On the other hand, Technology is not impersonal; it is not of nature but of man, and now that it is showing power to direct man as a species, is becoming Technology with a capital T, the new god, man's creation of an extension of himself to which he seems inclined to relinquish his power of free will which we have prized so much and accepted as being part of our difference, our apartness, from the animal world'.

One of the most perturbing aspects of the pollution by technocracy, success story is the creation and release into aquatic ecosystems of pollutants of a different chemical nature from normal 'natural' pollutants, e.g., sewerage. Thus we have organophosphorus, organochlorine compounds, being released into aquatic ecosystems; the effects of which we know very little about. Thus concentrations of PCB's or polychlorinated biphenyls have now been found to be of significance in a wide array of sea bird and fish fatalities. The long term effects of PCB's are unknown, though we do know that they exert serious physiological effects in low concentrations, that they can be biologically concentrated and they are persistent in aquatic ecosystems for a considerable number of years. The same applies for many radioactive and pesticide residues.

However, many of the pollutants being released into aquatic ecosystems are not new molecules, but are, in fact, molecules of great antiquity. Some of these pollutants in small amounts are essential to the metabolism of plants and animals, e.g., zinc, copper. For example, molluscs and crustaceans use copper as a constituent of the blood pigment, haemocyanin. Zinc is used in minute amounts in the enzyme, carbonic anhydrase. However, above very low background levels, such heavy metal ions are toxic.

I have been involved in work on two cases of heavy metal pollution of river ecosystems. The first was a case of zinc pollution, which I worked on in my Honours year at A.N.U. The river affected was the Molonglo River, which after meeting the Queanbeyan River, swells to enhance the symmetrical puzzle of Canberra, by forming Lake Burley Griffin. Unfortunately at Captains Flat on the upper Molonglo River, zinc and copper mining in the

past -- the operations ceased in 1962 -- had lead to extensive tailings, containing zinc, being distributed along the river banks for some distance (15 km.). Leaching from these tailings and run-off in times of rain lead to zinc ending up in the river. If one examined the chemical conditions alone of the river, one may be excused for concluding that the river was only mildly polluted. From an ecological point of view, the river is in a bad way. In the more heavily polluted sections of the river, 40 kilometres or so, whole components of a normal stream fauna (as judged by sampling neighbouring streams) were either very poorly represented or missing. Components such as the molluscs, crustaceans, stone flies and fish were very poorly represented. In experiments carried out in the river, zinc levels of 1 p.p.m. were sufficient to kill trout (brown and rainbow). In the case of the Molonglo River, I doubt whether the ecosystem will ever adequately recover from the pollution; even if the pollutants are reduced to harmless levels.

It appears to be a general ecological rule that ecosystems that have been damaged very rarely return to their original condition. After abatement of pollution, there will be a development of a possibly stable ecosystem but there is only a very slim chance that this new ecosystem will bear a resemblance to the original undisturbed ecosystem. There is a common fallacy in many people's minds that if the operation of environmentally disturbing forces ceases, there will be a return to the pristine state of the original ecosystem.

In the case of the Molonglo River there appears to be a general acceptance of the pollution, though some graziers were not happy with losing valuable river flats, and some trout fisherman were not happy with losing what was once a thriving fishery. In some parts of the river, the levels of zinc are not high enough to harm trout, yet they are absent. This appears to be due to the fact that fish can detect very low levels of zinc in the water and will refuse to migrate into waters so affected.

In another case of heavy metal pollution, on which I, along with others of this University have worked, there is quite clearly a case of conflict as to the possible uses to which a river may be put. I am referring to the South Esk River, which from just above Avoca to Evandale is polluted with cadmium and zinc. The pollution is due to mining activities in the watersheds of Aberfoyle and Story's Creeks. The effect of the pollution has been to drastically reduce the number of species and the abundance of animals in the stream ecosystem. Whole taxonomic groupings such as the Annelida, the Crustacea and the Mollusca are missing from the polluted stretches.

At Avoca, the South Esk River harbours a depauperate stream fauna. However, by walking a short distance, to the first big pool in the St. Pauls River, one returns to a rich and diverse stream fauna. Trout are in St. Pauls River but not in the polluted stretches of the South Esk River.

Incidentally, cadmium is a very toxic substance and is a heavy metal which is now leading to considerable environmental concern; in some cases, even by people relatively unconcerned about pollution by other heavy metals.

The first basis for concern is that the industrial use of cadmium is rising very rapidly from a world production of 5,000 tons in 1950 to 16,000 tons in 1970. The second cause for alarm is that in very small quantities (1-2 p.p.m.), cadmium in human beings exerts an array of very undesirable effects such as irreversible kidney damage and reversible hypertension. In higher concentrations it leads to the lethal condition of 'Itai-Itai' (ouch-ouch disease) in which bones are literally etched away.

Chemically, in many cases, the pollution may be regarded as being only slight. However four biological phenomena allow contradiction of such an assessment. Firstly, an animal in its lifetime only needs to die once from poisoning. Thus after heavy rains in both systems that I've investigated, the concentrations of heavy metals rise to quite high levels for a short pulse of time. As long as this only happens once a year or possibly at even longer time intervals, the ecosystem will be damaged. Secondly, even in very low external concentrations of heavy metals, animals and plants may 'biologically concentrate' internally such materials, so that in their bodies, the concentration of such materials far exceeds often by factors of thousands, the concentration in the surrounding water. The well-documented story of mercury in Swedish freshwater ecosystems is an example. Locally, we have the distinctive phenomenon of galvanised oysters. Thirdly, there is the fact that at low sub-lethal levels, many pollutants impair normal metabolic functions. One of the most common forms of impairment is an interruption of reproduction. This may lead to a negative population growth rate and to the possible demise of the species concerned in the affected ecosystem. Fourthly, many species of animals, progress in their development through a number of different stages. In many cases while adults can survive quite heavy pollution, the juvenile stages are susceptible. Thus work on fiddler crabs, Uca, has revealed that while adults can survive in concentrations of 1 p.p.m. of mercuric chloride for considerable lengths of time, larvae die within 24 hours. Adult oysters can survive quite high concentrations of zinc up to 100 to 500 micrograms per litre almost indefinitely but such concentrations are lethal to settling oyster larvae.

The South Esk case also exemplifies the very common situation where excesses of one form of human activity can lead to a damaging of the ecosystem for other human enterprises. There is no doubt in the region of the South Esk affected that angling is non-existent, farming has been adversely affected and the use of the river as a water supply is limited. Indeed watershed management the means of satisfying a number of different uses, is an unknown field of endeavour in Australia. In Tasmania, we do not have the means for setting up comprehensive watershed management. Here each agency, with an apparent minimum of consideration for other values, simply does its own thing, as quickly as money will allow.

Another major method for degrading aquatic ecosystems is to purposefully alter the morphology of water and land interaction. One would hardly think that in Tasmania, one would have to elaborate on this kind of intervention. for the island is pock-marked with examples, ranging from the flooding of an entire lake's ecosystem through to the total destruction of highly productive estuarine mud flats by reclamation.

There has been the wholesale diversion of river systems and the conversion of rivers into series of biologically drab reservoirs. There has been the alteration of lacustrine ecosystems by lifting the levels of lakes. Recent work by us with the Inland Fisheries Commission on Great Lake has suggested that although the level of the lake was first lifted in 1916, the invertebrate benthic fauna has not yet adequately colonized these flooded regions of the lake. From an invertebrate point of view, that part of the shore of Great Lake most recently inundated is a biological desert.

Often superimposed on large permanent changes in lake levels, there is the effects of short-term but rapid changes of lake levels by the drawing off of water for hydro-electric or irrigational purposes. Such short-term changes are needless to say, highly damaging to the invertebrate fauna. There has not been much investigation of this problem in Tasmania. In Wales at a reservoir called Llyn Tegid, Hunter and Jones (1972) were able to show that irregular water fluctuations seriously reduced the shore or littoral fauna. Regulation of water usage leading to reduced water level fluctuations resulted in a build-up of the littoral fauna. In Tasmania, a reduction in the extent of rapid water level fluctuations would be rewarding both to the biologist and to the trout fisherman. A strict control on water level fluctuations in Shannon Lagoon and Penstock Lagoon may ensure the survival of a highly interesting and unique species of crustacean, Paranaspides lacustris. In a similar vein the construction of some fish ladders on our hydro-electric schemes would certainly benefit the fisheries in those rivers straddled with dams. The provision of fish ladders in some of the dams of the Derwent River, would undoubtedly increase the productivity of the recreationally valuable trout fishery and the commercially valuable eel fishery of the Derwent and some of its tributaries. Indeed in some nations with both extensive hydro-electric schemes and valuable fisheries based on migratory species of fish, such as salmon, the building of fish ladders in hydro-electric schemes is mandatory.

Other means of damaging aquatic ecosystems by physical means include the conversion of winding streams into drab straight drainage ditches, the removal of snags and vegetation from stream courses, dredge mining and quarrying operations and the process of destructive reclamation.

Indirectly by either complete or well-balanced mismanagement man can alter aquatic ecosystems. Examples of such indirect assault abound. One of the most obvious ones is that caused by soil erosion on watersheds. Thus grazing and frequent fires have undoubtedly led to problems of run-off and siltation in streams and lakes of the Central Plateau. There is clearly the need for a comprehensive management plan for this part of Tasmania.

Finally on top of these forces of environmental alteration, we have the dilemma of the deliberate introduction of alien species. Some of them are plants, e.g. willows, blackberries, but most of them are fish; most come from Europe; most are predators. Such species include trout (brown, rainbow, and brook), carp, tench, perch, roach, and mosquito fish. Undoubtedly these introductions have had adverse effects on the biota of native aquatic ecosystems. In their favour, the presence of a trout fishery has probably awakened some to the need to conserve aquatic ecosystems and has satisfied the sporting prowess of some. Thus, a well managed trout fishery in this

state could certainly be a great asset. But, what I object to is the unnecessary introduction of some species, e.g., tench and the almost fanatical zeal displayed in this state, whereby trout have been or are being introduced into almost every water body. This is exemplified by a quotation from a recent book on trout fishing in Tasmania. 'Such a wonderful job was done by our forefathers in distributing stocks of young fish throughout the state that now there is not a river system in the state that is not adequately stocked with brown trout.' Many introductions, in my opinion, have been wasteful in that some of the areas affected have only been rarely fished, and in other cases, the fishery developed has turned out to be a poor one; and this, in some cases, could have been predicted by biologists. I think that in this state, with a highly interesting and unique aquatic fauna, efforts should be made to keep some ecosystems clear of alien fish.

Thus we have a powerful arsenal of methods by which man can degrade ecosystems. In Australia, the methods have been only too well applied. Perhaps some day an historical ecologist or vice versa will write a full account of the destruction of Australia's native ecosystems. Perhaps to more fully understand ourselves such an account is as important as the history of our political and social systems. Possibly the ferocity of the environmental alteration was due to a powerful sense of alienation, coming as exiles from a society into which one did not really belong to a land which was strange. As Fraser Darling notes 'It is one of the unfortunate paradoxes that a conscious sense of conservation seems to come only after a long period of devastation has made the need apparent'.

The processes, which I have outlined, have been allowed to operate largely unchecked, because other values especially those of a non-monetary kind have not been considered at the planning stage - that is if planning occurred. The only time where clashes of interests have had to be resolved, have been in those situations where one economic use of an ecosystem has been impaired by the activities of another use. In many cases, the resolution of the problem has been by tacit agreement rather than by investigation, and certainly not by investigation and consideration of ecologically-based or 'environmental' values. After the Lake Pedder business, it is now clear that in Australia, in the planning of large-scale alterations to the natural environment, values other than those based on economic interest should receive full consideration and alternative proposals should be fully investigated and discussed. As Sir Garfield Barwick has stated, one must 'indeed hope that no other part of Australia will be pedderised - i.e. unnecessarily damaged as a result of inadequate consideration of all the values concerned and without adequate disclosure to the public of the contemplated use.' After all many of the battles between developers and conservationists involve Crown Land - land owned by the people of the state and managed on their behalf by the government of the day.

As I stated in my evidence to the infamous and much hindered Lake Pedder Inquiry, there is very obviously the need in Tasmania for means to be established such that areas likely to be significantly altered by developmental enterprises can be investigated with values other than those of economic interest being equally considered. In my opinion, in such cases, the investigation of one set of economic values should not be supported

by the state at the expense of the investigation of non-economic or 'environmental' values. Similarly, in my opinion, the investigation of other values should be initiated at the same time as the investigations of the economic values are initiated.

It is quite clear that in planning and decision-making in our society, environmental values will have to be fully considered. The prevalent measure of success of society - the rate of economic expansion, is now being seriously questioned by people holding new, perhaps at present, rather incoherent sets of values. As J.K. Galbraith states "Environment is a code word for much else. It is a way of bringing dissatisfaction with the old tests of economic achievement into focus in a form that is easily perceived by the average person. All see that the price of economic growth is pollution of the air, pollution of the water, damage to the tranquility of surroundings, corruption of the countryside. So damage to the environment has certainly been one of the leading, perhaps the leading reason, why people have come to question economic growth as the ultimate goal of man." He adds "We now have a more incoherent set of goals in which intellectual purpose has some role, artistic purpose has some role; new modes of life have some role. The sense of whether one is living a reflective and tranquil existence has begun to take on some meaning. "All of this has an aspect of chaos for people who were reared to believe in the simpler tests of economic performance." Economic growth with effective control of population, resource utilization and pollution is probably possible - though there is a great reluctance to experiment in this direction.

Returning to aquatic ecosystems, especially freshwater ones, I have described means of ecosystem degradation - in many cases ecosystem degradation as a result of economic development. But what of the 'environmental' values of such systems? What fits into the category of such values? Some of these values as I see them include (1) the value of a clean environment; (2) the value of intact ecosystems; (3) the value of species and (4) the value of wilderness. This list is by no means exhaustive.

(1) The value of a clean environment is a very obvious one, and one which most people are in agreement. To maintain this value means simply to abate or prevent pollution, which most governments by token gesture or firm effort are now attempting to do.

Contamination of food from aquatic sources is now proving to be a problem. In Japan it has recently been suggested that due to heavy metal pollution, people should eat no more than 6 prawns a week, 1 lb. of tuna etc., and pregnant women and children are advised against eating fish at all. Many people see food from the sea as a source of food for increasing population. Unfortunately at the same time, we are polluting the sea with heavy metals and a whole range of highly persistent chemicals. Thus the marine food, especially that from the most productive part of the sea, the inshore areas, may be becoming more and more contaminated. In this context, one cannot approve the dumping of heavy metal containing wastes offshore in Tasmania. But no doubt, in the future, technology will provide ways to extract heavy metals from fish flesh.

(2) The value of intact ecosystems - as opposed to battered, unbalanced ecosystems: Intact ecosystems tend to be in a state of equilibrium, with the stability being achieved by a diversity of components. Many of man's activities lead to the production of depauperate, unbalanced, non-cyclic imitations of natural ecosystems. Properly assessed, man can however use ecosystems without causing disruption and can thus maintain them as renewable resources. He can also convert them into non-renewable resources by unwise planning.

Natural ecosystems, because of their cyclic nature, can be judged as being essential to man's long term existence, for they are, to us an Ehrlichian phrase, 'the life-support systems of planet Earth'.

Intact aquatic ecosystems are highly prized by ecologists and biologists. From studying them we can gain some comprehension of the patterns and forces involved in their evolution, in the means by which they maintain equilibrium; in the ways species relate to each other in an ecosystem, in the ways energy and biogenic materials flow through ecosystems; in the possible ways that man can repair damaged ecosystems; in the ways that natural ecosystems may be cropped without adversely affecting them. Needless to say our comprehension of such concepts is at present very limited, and without adequate support for their description and analysis is likely to remain so.

Natural ecosystems are being damaged or destroyed progressively with time, they are certainly not being renewed or replaced. Of course, in the eyes of some, such a situation poses no great difficulties.

(3) The value of species of plants and animals: Many extinctions of species have been unavoidable and not due to man. But with the spread of man's activities on this planet, extinction has been meted out to an increasing number of species. By either exploitation or habitat alteration, man has made many species either extinct or rare. Basically, I feel that the unnecessary, avoidable extinction of a species is the admission of a very dangerous trait - the unhealthy desire to conquer nature rather than live in even an uneasy truce with nature. Some judge extinctions and depletion of species as not only being unhealthy but immoral. Extinction is a final step; the elimination of that genetic assemblage which makes up a particular species. As Otto Frankel has pointed out conservation of the genetic resources of the planet is of vital importance.

Apart from the value of a species as an ecosystem component, species at present only of aesthetic or academic interest may well be useful to man in the future. To a biologist, the destruction of a species is a destruction of the basic material of study. Perhaps the awareness of this situation has been why many biologists have been outspoken in their opposition to many projects of environmental alteration. In Tasmania, of course, we have the situation where the unique beach habitat of Lake Pedder has been inundated with the possible loss of up to 20 endemic species. The species of interest at Lake Pedder were not visibly obvious, but yet were valuable scientifically. One can readily see the situation where if one of these species had been large, very obvious and preferably either furry or feathered, public support for saving the lake may well have been much stronger much earlier.

(4) The value of natural wilderness areas: The most obvious aspect of this value is the simple aesthetic delight that one can get from seeing either a beautiful landscape or waterscape. The diversity of moods and natural form can be a highly exciting experience; even for people used to natural surroundings - but more so to people entrapped in artificial environments. Further, it can be argued that areas of natural landscape, because of their low population density and their diversity and tranquility can satisfy the need of soothing people under stress in the complexities of the urban-industrial complex.

Even further, there are possibly even those in our Western culture who may find some spiritual or religious sense in the contemplation of nature. It is highly unfashionable pastime or occupation in our society, being possibly last acceptable with the English Romantics such as Wordsworth. I fear that much of Wordsworth's poetry is virtually meaningless now to many people.

It is hard to see modern rationality coming easily to terms with, for example, that piece from 'The Conclusion' to 'The Prelude', where as a young man Wordsworth is climbing Mt. Snowden and is caught up in banks of swirling mist -

'There I beheld the emblem of a mind
That feeds upon infinity, that broods
Over the dark abyss intent to hear
Its voices issuing forth to silent light
In one continuous stream; a mind sustained
By recognitions of transcendent power
In sense conducting to ideal form
In soul of more than mortal privilege...'

Coupled with each one of these environmental values, there is the value of aquatic ecosystems as areas satisfying physical recreational needs, e.g., fishing, boating. The ambit of such a value undoubtedly accommodates some degree of economic values, and as such they have often more weight in conflicts of planning than simple environmental values.

I have not stated the numerous forms of economic values which hang over almost any aquatic ecosystem. Such values are obvious. All one can say, is that in our technocratic society, economic values have figured uppermost in planning decisions.

We need to arrive at a process in decision-making by which environmental values can be considered to be of equal weight to economic values. Such a step will not be achieved without public pressure and possibly not without a change in our political system. For as Galbraith has observed, in our present governmental procedure, the functions of gathering and interpreting information, regulation and the implementation of decisions are often all encompassed in one organization. In his view, to ensure a more rational and reliable system of selecting optimal management strategies, we must separate administratively, the functions of collecting and interpreting data, action and regulation.

Personally, I find it difficult to see how the administrative structure which we have constructed in order to exploit the environment, can be made amenable to the ethics of protecting the environment, without extensive and far-reaching changes.

Throughout the discussion so far, I have adopted the conventional viewpoint as regards ecology and conservation. Conservation in such a context may be viewed as a process of ensuring that a resource is managed for the most environmentally-sound, long term interests of man. Ecology in this context is viewed as a science offering guidelines for effective conservation. However recently there have been subterranean rumblings in our society suggesting that ecology is more than just another science. Theodore Roszak in his recent book 'Where the Wasteland Ends' outlines some of the ways in which ecology is regarded by the 'counter-culture'. 'Ecology is through and through judgemental in character. It cannot be value-neutral.' 'Ecology is the closest our science has yet come to an integrative wisdom. It, and not physics, deserves to become the basic science of the future'. 'It is the one science that seems capable of assimilating moral principle and visionary experience and so of becoming a science of the whole person'. At present, in our society, there is a definite eco-movement of some passion arising, and pleas for the adoption of an 'ecological morality' have come from a variety of quarters. Such a development may well affect the process of decision-making.

It is thus possible that by accepting the new 'environmental' values in decision-making systems, we at the same time orientate society toward accepting new goals, beside those of economic achievement. From an environmental point of view, such goals could firstly include adjusting the population-environment relationship as quickly as possible so that the quality of life will be optimal for as long as possible in the future and secondly to systematically avoid any activity that will produce large scale instability in the population-environment system at any time in the future.

Such goals while appearing to be straightforward but unapproachable, would be impossible to achieve without an elaborate and ambitious action program involving such items as:-

- (1) Providing strong, governmentally supported incentives for population regulation, and to determine the optimum population size for each country, for each region and then trying to attain that demographic situation as quickly as possible.
- (2) Use all resources in the most environmentally inoffensive yet as wise a manner as possible. Such resources include food, land, water, energy, soil, minerals and human time.
- (3) Develop an economic theory based on equilibrium.
- (4) Routinely monitor the physical, chemical and biological state of the planet and firmly control excesses.
- (5) Legislate rigidly and effectively against any activity which can cause large-scale environmental instability.

- (6) Guarantee all citizens a basic set of environmental rights.

The goals may be impossible but by moving toward them, we may be able to weld the broken trust between man and his environment.

* * * * *

BOOK REVIEW

HELEN I. ASTON. 1973. Aquatic plants of Australia. Published by Melbourne University Press. 368 p. Recommended price: \$21-00.

Botanists in south-eastern Australia must now be feeling relatively contented with the state of their local taxonomic knowledge. Following close after volume 2 of Willis' "Handbook to plants in Victoria", Burbridge and Gray's "Flora of the A.C.T.", and Specht's "The vegetation of South Australia", comes another: Aston's "Aquatic plants of Australia".

Helen Aston, an ASL member of long-standing, is to be congratulated on the production of this guide - a very admirable attempt to document the complete Australian flora of native and introduced aquatic ferns and flowering plants. The coverage extends also to the algal genera Chara and Nitella among the Characeae, both of which might be mistaken for true angiosperms, and to conspicuous species of liverwort. Sedges and grasses are for the most part omitted.

Altogether 222 species are mentioned, nearly half of which occur in Victoria. The information is generally more comprehensive for Victorian species; the author has been able to examine these at first hand, and supplement distribution records with her own observations. In most cases, the information given for species occurring elsewhere in Australia necessarily is limited, and drawings often are not included. The major value of the book clearly will be for workers in the south-eastern part of the continent.

The book is meticulously written and printed. Most species descriptions are accompanied by pen-and-ink drawings, and notes on distribution and ecology are included, together with references to recent taxonomic work. The taxonomic section is preceded by notes on physiographic and climatic features of Australia (and Victoria in particular), by an excellent glossary of botanical terms, and also

by a guide to the construction and use of taxonomic keys. Keys are, however, not a major feature of the book: the author has intentionally limited their use on the grounds that some major taxa are represented by only a few species. Those keys provided relate to genera and species within genera, but there are few diagnoses for families or monotypic genera. Instead we are advised by the author to use the book as a picture-key for discerning major taxa, and to then investigate the relevant descriptions. However, I think use of the book as a picture-key is likely to prove difficult if the user is not already well-acquainted with aquatic plants, since diagrams are not included for all species, and different scales are used for the various characters. Coloured plates would have been useful, but it is easy to imagine why they are not included. From my own point of view, and I suspect for many others, the lack of a main taxonomic key is a significant disadvantage.

Passing mention might be given the interesting collation of historical information on outbreaks of the water hyacinth, Eichhornia crassipes, and also the handy distribution charts of species in the various states, both contained in appendices. Location maps and a select bibliography also are provided.

Helen Aston's book will find a very willing acceptance among botanists/limnologists, irrigation and water resource authorities, and others. I would earnestly recommend it to those with any hydrobiological leanings.

K.F. Walker

* * * * *

AMENDMENTS TO THE THIRD EDITION OF THE
DIRECTORY OF AUSTRALIAN LIMNOLOGISTS

DODD, William A.

Lecturer

Department of Biology and
Environmental Science
Queensland Institute of Technology
P O Box 246
North Quay, Qld. 4000

GILES, Max S. B.Sc.

Australian Atomic Energy Commission
Research Establishment
Lucas Heights, NSW 2232.

General ecological effects of pollution
of aquatic environments by heavy metals
and heat.

KING, C.

Department of Biology and Environmental Science
Queensland Institute of Technology
P O Box 246
North Quay, Qld. 4000

McIVOR, C.

Department of Biology and
Environmental Science
Queensland Institute of Technology
P O Box 246
North Quay, Qld. 4000

WILLIAMS, Neville J. Dr Wis. Nat.

Atomic Energy Commission
Research Establishment
Lucas Heights, NSW 2232

Pollution by heavy metals and heat - behavioural
and ecological effects on fishes. Australian
bass systematics and ecology.

PLEASE INSERT THESE
AMENDMENTS INTO YOUR
COPY OF THE DIRECTORY

TO: Don Buckmaster

Fisheries and Wildlife Division

Arthur Rylah Institute

123 Brown Street

HEIDELBERG, Vic. 3084

I enclose a cheque/money order for \$_____ as
my annual subscription for 1973/74 to the Australian
Society for Limnology.

Signed: _____

Name: _____

Address: _____

* Ordinary and affiliated members : \$6.00

* Student members : \$3.00

